CLAIMS

WE CLAIM:

1. A method of operating a high field MRI system comprising the steps of:

(a) acquiring NMR signals from a patient;

(b) extracting tissue temperature data from at least some of the NMR signals;

(c) extracting tissue image data from at least some of the NMR signals for the production of an MRI image; and

(d) repeating steps (a)-(c) while the tissue temperature measurements are below a safety threshold.

2. The method of claim 1 further including the step of changing the rate of acquiring the NMR signals as a function of tissue temperature.

3. The method of claim 1 including the step of halting only the acquisition of NMR data for the extraction of tissue image data when the tissue temperature measurements are above the safety threshold and not the NMR data for the extraction of tissue temperature data.

4. The method of claim 1 including the step halting the acquisition of NMR data for a predetermined cooling period when the tissue temperature measurements are above the safety threshold.

5. The method of claim 3 wherein the predetermined cooling period is determined from a mathematical model of tissue cooling.

6. The method of claim 1 wherein step (b) and step (c) extract data from NMR signals obtained in different acquisitions.

7. The method of claim 1 including the step of extracting baseline tissue temperature data from the NMR signals at a time of known patient temperature and wherein the step of extracting tissue temperature data from the NMR signals employs the baseline tissue temperature.

8. The method of claim 7 wherein the time of known patient temperature is at the beginning of acquiring NMR signals from the patient.

9. The method of claim 7 wherein the known patient temperature is a measured body temperature of the patient.

10. The method of claim 1 wherein the extracting tissue temperature data from the NMR signals monitors temperature dependent phase shift of the NMR signals.

11. The method of claim 1 wherein the extracting tissue temperature data from the NMR signals detects saturation of spins by a narrow band saturating RF waveforms at a resonant frequency of protons at temperatures at the safety threshold.

12. A high field MRI system comprising:

a polarizing magnet sized to receive at least a portion of a patient;

RF transceiver electronics for stimulating the patient tissue in the polarizing magnetic field to acquire NMR signals from a patient;

image processing electronics operating to:

(i) extracting tissue temperature data from at least some of the NMR signals;

(ii) extracting tissue image data from at least some of the NMR signals for the production of an MRI image; and

(iii) repeating collection of NMR signals for the production of an MRI image only while the tissue temperature measurements are below a safety threshold.

13. The high-field MRI system of claim 12 wherein the image processing electronics further changes the frequency of acquiring NMR signals as a function of tissue temperature.

14. The high-field MRI system of claim 12 wherein the image processing electronics further halts only the acquisition of NMR data for the extraction of tissue image data when the tissue temperature measurements are above the safety threshold and not the NMR data for the extraction of tissue temperature data.

15. The high-field MRI system of claim 12 wherein the image processing electronics further determines the predetermined cooling period from a mathematical model of tissue cooling.

16. The high-field MRI system of claim 12 wherein the image processing electronics extracts tissue temperature and tissue image data from different NMR signals obtained in different acquisitions.

17. The high-field MRI system of claim 12 wherein the image processing electronics further operates to extract baseline tissue temperature data from the NMR signals at a time of known patient temperature and wherein the extraction of temperature data from the NMR signals employs the baseline tissue temperature.

18. The high-field MRI system of claim 12 wherein the time of known patient temperature is at the beginning of acquiring NMR signals from the patient.

19. The high-field MRI system of claim 12 wherein the known patient temperature is a measured body temperature of the patient.

20. The high-field MRI system of claim 12 wherein the image processing electronics extracts temperature data from the NMR signals by monitoring temperature dependent phase shift of the NMR signals.

21. The high-field MRI system of claim 12 wherein the image processing electronics extracts tissue temperature data from the NMR signals detects saturation of spins by a narrow band saturating RF waveform at a resonant frequency of protons at temperatures at the safety threshold.

23. A local coil comprising:

an antenna array coupling to a region of interest in a patient;

a conductor for connecting the antenna array to signal processing circuitry of an MRI machine; and

a local oscillator producing a narrow band radiofrequency signal saturating tissue protons only when the tissue has reached a safety temperature limit.

24. The local coil of claim 23 wherein the local oscillator includes a signal lead communicating with the MRI machine to turn the local oscillator on and off.

25. A computer program for execution on a MRI machine comprising the program steps of:

(a) acquiring NMR signals from a patient;

(b) extracting tissue temperature data from at least some of the NMR signals;

(c) extracting tissue image data from at least some of the NMR signals for the production of an MRI image; and

(d) repeating steps (a)-(c) while the tissue temperature measurements are below a safety threshold.

26. The computer program of claim 25 including the program step of halting the acquisition of only NMR data for the production of an MRI image and not NMR data for the production of tissue temperature when the tissue temperature measurements are above the safety threshold.

27. The computer program of claim 25 including the program step of halting the acquisition of NMR data for a predetermined cooling period when the tissue temperature measurements are above the safety threshold.

28 A method of modeling the thermodynamic qualities of tissue comprising the steps of:

(a) exposing the tissue to RF energy at least in part incident to the acquisition of NMR signals from a patient;

(b) extracting tissue temperature data from the NMR signals; and

(c) modeling the tissue based on the temperature change of the tissue as a function of deposited RF energy.